

Table 3



Sample	Material composition (mass %)					Sintering condition		HIP condition		Porosity (%)	Three point bending strength (MPa)	Fracture toughness (MPa·m ^{1/2})	Rolling fatigue life (cycle)	
	Si ₃ N ₄	Electro-conductivity rendering agent	Rare earth element oxide	Al ₂ O ₃	AlN	Other component	temperature × time × pressure (°C) × (hr) × (MPa)	temperature × time × pressure (°C) × (hr) × (MPa)	Electric resistance (Ω · cm)					
2	65	12	Mo ₂ C	12	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 9 × 10 ⁶	1020 6.5 >1 × 10 ⁷
3	59	20	Mo ₂ C	10	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 4 × 10 ⁴	1040 6.3 >1 × 10 ⁷
4	58	28	Mo ₂ C	3	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 2 × 10 ³	1020 6.1 >1 × 10 ⁷
5	55	19	Mo ₂ C	15	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 1 × 10 ⁴	980 6.1 >1 × 10 ⁷
6	75	17	Mo ₂ C	4	Y ₂ O ₃	2	2	—	—	—	1850 × 4 × 0.9	1700 × 1 × 98	Up to 0.01 1 × 10 ⁷	950 6.2 >1 × 10 ⁷
7	63	16	Mo ₂ C	8	Y ₂ O ₃	10	2	1	—	—	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 1 × 10 ⁶	1000 6.5 >1 × 10 ⁷
8	62	16	Mo ₂ C	8	Y ₂ O ₃	4	5	4	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 30	Up to 0.01 9 × 10 ³	1050 6.4 >1 × 10 ⁷
9	64	16	Mo ₂ C	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1850 × 4 × 0.9	—	0.2 2 × 10 ⁵	980 6.6 >1 × 10 ⁷
10	63	20	Mo ₂ C	3	Y ₂ O ₃	4	3	2	TiO ₂	5	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 3 × 10 ⁶	1040 6.1 >1 × 10 ⁷
11	58	20	Mo ₂ C	10	Y ₂ O ₃	4	3	3	ZrO ₂	2	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 5 × 10 ⁴	1070 6.4 >1 × 10 ⁷
12	58	20	Mo ₂ C	10	Y ₂ O ₃	4	3	3	HfO ₂	2	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 4 × 10 ⁴	1080 6.4 >1 × 10 ⁷
13	64	16	MoSi ₂	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 9 × 10 ⁴	1080 6.6 >1 × 10 ⁷
14	64	16	WC	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 5 × 10 ⁵	1050 6.4 >1 × 10 ⁷
15	64	16	TaC	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 3 × 10 ⁵	1100 6.6 >1 × 10 ⁷
16	64	16	NbC	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 9 × 10 ⁴	1120 6.7 >1 × 10 ⁷
17	61	16	Mo ₂ C	10	Er ₂ O ₃	7	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 1 × 10 ⁵	1100 6.7 >1 × 10 ⁷
18	63	16	Mo ₂ C	10	CeO ₂	5	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 1 × 10 ⁵	1010 6.6 >1 × 10 ⁷
19	63	16	Mo ₂ C	10	Nd ₂ O ₃	5	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 2 × 10 ⁵	1080 6.5 >1 × 10 ⁷
20	61	16	Mo ₂ C	10	Dy ₂ O ₃	7	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 30	Up to 0.01 1 × 10 ⁵	1100 6.6 >1 × 10 ⁷
4	71	10	Mo ₂ C	8	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 1 × 10 ⁸	1100 6.8 >1 × 10 ⁷
5	53	30	Mo ₂ C	6	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 1 × 10 ⁴	920 5.8 8 × 10 ⁶
6	70	17	Mo ₂ C	2	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 2 × 10 ⁸	1070 6.7 >1 × 10 ⁷
7	53	19	Mo ₂ C	17	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	0.05 8 × 10 ³	890 5.9 8 × 10 ⁶
8	66	16	Mo ₂ C	10	Y ₂ O ₃	1	3	3	TiO ₂	1	1850 × 4 × 0.9	1700 × 1 × 98	0.1 4 × 10 ⁵	870 5.7 7 × 10 ⁶
9	55	16	Mo ₂ C	10	Y ₂ O ₃	12	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 2 × 10 ³	900 5.9 8 × 10 ⁶
10	61	20	Mo ₂ C	3	Y ₂ O ₃	4	3	2	TiO ₂	7	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01 2 × 10 ⁶	890 6.0 9 × 10 ⁶

Table 4

Sample	Material composition (mass %)					Sintering condition		HIP condition		Crushing strength (MPa)	Rolling fatigue life (hr)	Defects static electricity
	Si ₃ N ₄	Electro-conducting agent	Rare earth element oxide	Al ₂ O ₃	AlN	Other component	temperature x time x pressure (°C) x (hr) x (MPa)	temperature x time x pressure (°C) x (hr) x (MPa)				
2B	65	12	Mo ₂ C	12	Y ₂ O ₃	4	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	240
3B	59	20	Mo ₂ C	10	Y ₂ O ₃	4	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	250
4B	58	28	Mo ₂ C	3	Y ₂ O ₃	4	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	230
5B	55	19	Mo ₂ C	15	Y ₂ O ₃	4	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	260
6B	75	17	Mo ₂ C	4	Y ₂ O ₃	2	2	—	—	1850 x 4 x 0.8	1700 x 1 x 98	210
7B	63	16	Mo ₂ C	8	Y ₂ O ₃	10	2	1	—	1800 x 4 x 0.7	1700 x 1 x 98	220
8B	62	16	Mo ₂ C	8	Y ₂ O ₃	4	5	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	255
9B	64	16	Mo ₂ C	10	Y ₂ O ₃	4	3	TiO ₂	1	1850 x 4 x 0.9	—	230
10B	63	20	Mo ₂ C	3	Y ₂ O ₃	4	3	TiO ₂	5	1800 x 4 x 0.7	1700 x 1 x 98	240
11B	58	20	Mo ₂ C	10	Y ₂ O ₃	4	3	ZrO ₂	2	1800 x 4 x 0.7	1700 x 1 x 98	250
12B	58	20	Mo ₂ C	10	Y ₂ O ₃	4	3	HfO ₂	2	1800 x 4 x 0.7	1700 x 1 x 98	255
13B	64	16	MoSi ₂	10	Y ₂ O ₃	4	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	250
14B	64	16	WC	10	Y ₂ O ₃	4	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	240
15B	64	16	TaC	10	Y ₂ O ₃	4	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	250
16B	64	16	NbC	10	Y ₂ O ₃	4	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	270
17B	61	16	Mo ₂ C	10	Er ₂ O ₃	7	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	260
18B	63	16	Mo ₂ C	10	CeO ₂	5	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	230
19B	63	16	Mo ₂ C	10	Nd ₂ O ₃	5	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	240
20B	61	16	Mo ₂ C	10	Dy ₂ O ₃	7	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	250
4B	71	10	Mo ₂ C	8	Y ₂ O ₃	4	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	250
5B	53	30	Mo ₂ C	6	Y ₂ O ₃	4	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	190
6B	70	17	Mo ₂ C	2	Y ₂ O ₃	4	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	230
7B	53	19	Mo ₂ C	17	Y ₂ O ₃	4	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	185
8B	66	16	Mo ₂ C	10	Y ₂ O ₃	1	3	TiO ₂	1	1850 x 4 x 0.9	1700 x 1 x 98	180
9B	55	16	Mo ₂ C	10	Y ₂ O ₃	12	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	200
10B	61	20	Mo ₂ C	3	Y ₂ O ₃	4	3	TiO ₂	7	1800 x 4 x 0.7	1700 x 1 x 98	190
												370
Comparative example												No defect

